CLAIMS:

1   1.   A method for transmitting a digital

2   signal comprising:

3   providing first and second streams of digital

4   data;

5   reordering the digital data of the first

6   stream of digital data in accordance with a first

7   interleave to provide a third stream of digital data;

8   and,

9   reordering the digital data of the second and

10   third streams of digital data in accordance with a

11   second interleave comprising an inverse of the first

12   interleave to provide a time multiplexed output

13   comprising the second stream of digital data reordered

14   according to the second interleave and the third stream

15   of digital data reordered to reflect the order of the

16   first stream of digital data.

1   2.   The method of claim 1 wherein the

2 digital data in the first stream of digital data are

3 robust VSB data, and wherein the digital data in the

4 second stream of digital data are ATSC data.

1   3.   The method of claim 1 wherein the

2 reordering of the digital data of the first stream of

3 digital data comprises:

4   providing dummy first stream digital data;

5   replacing the dummy first stream digital data

6 with digital data of the first stream of digital data;

7 and,

8   reordering the digital data of the first

9 stream of digital data in accordance with the first

10 interleave.

1   4.   The method of claim 1 wherein the

2 reordering of the digital data of the first stream of

3 digital data comprises:

4   providing dummy first stream digital data and

5 dummy second stream digital data;

6   replacing the dummy first stream digital data

7   with digital data of the first stream of digital data;

8   reordering the digital data of the first

9   stream of digital data and the dummy second stream

10   digital data in accordance with the first interleave to

11   provide the third stream of digital data; and,

12   wherein the reordering of the digital data of

13   the second and third streams of digital data comprises:

14   replacing the reordered dummy second stream

15   digital data in the third stream of digital data with

16   digital data of the second stream of digital data;

17   and,

18   reordering the digital data of the second and

19   third streams of digital data in accordance with the

20   second interleave.

1   5.   The method of claim 1 wherein the data

2   of the first stream of digital data are robust VSB

3   data, wherein the reordering of the digital data of the

4   first stream of digital data comprises:

5   providing a source of dummy VSB data and

6   dummy ATSC data;

7   replacing the dummy VSB data with the robust

8   VSB data; and,

9   reordering the robust VSB data and the dummy

10   ATSC data in accordance with the first interleave to

11   provide the third stream of digital data; and,

12   wherein the reordering of the digital data of

13   the second and third streams of digital data comprises:

14   replacing the dummy ATSC data in the third

15   stream with real ATSC data; and,

16   reordering the robust VSB data and the real

17   ATSC data in accordance with the second interleave.

1   6.   The method of claim 5 wherein the

2   replacing of the dummy ATSC data in the third stream

3   with real ATSC data comprises:

4   discarding the dummy ATSC data; and,

5   multiplexing the robust VSB data and the real

6   ATSC data.

1   7.   The method of claim 1 further comprising

2   outer coding auxiliary input data to provide the first

3   stream of digital data, wherein the outer coding

4   increases robustness of the auxiliary input data.

1   8.   The method of claim 7 wherein the outer

2   coding comprises:

3   reordering the auxiliary input data in

4   accordance with a third interleave to provide

5   interleaved auxiliary input data; and,

6   outer coding the interleaved auxiliary input

7   data to provide the first stream of digital data.

1   9.   The method of claim 7 wherein the

2 reordering of the digital data of the first stream of

3 digital data comprises:

4   providing dummy first stream digital data;

5   replacing the dummy first stream digital data

6 with digital data of the first stream of digital data;

7 and,

8   reordering the digital data of the first

9 stream of digital data in accordance with the first

10 interleave.

1   10. The method of claim 9 wherein the outer

2 coding comprises:

3   reordering the auxiliary input data in

4 accordance with a third interleave to provide

5 interleaved auxiliary input data; and,

6   outer coding the reordered auxiliary input

7 data to provide the first stream of digital data; and,

8   wherein the replacing of the dummy first

9 stream digital data with digital data of the first

10 stream of digital data comprises:

11   reordering the dummy first stream digital

12   data; and,

13   replacing the reordered dummy first stream

14   digital data with digital data of the first stream of

15   digital data.

1   11. The method of claim 7 wherein the

2   reordering of the digital data of the first stream of

3   digital data comprises:

4   providing dummy first stream digital data and

5   dummy second stream digital data;

6   replacing the dummy first stream digital data

7   with digital data of the first stream of digital data;

8   and,

9   reordering the digital data of the first

10   stream of digital data and the dummy second stream

11   digital data in accordance with the first interleave to

12   provide the third stream of digital data; and,

13   wherein the reordering of the digital data of

14   the second and third streams of digital data comprises:

15   replacing the reordered dummy second stream

16   digital data in the third stream of digital data with

17   digital data of the second stream of digital data;

18   and,

19   reordering the digital data of the second and

20   third streams of digital data in accordance with the

21   second interleave.

1   12. The method of claim 11 wherein the outer

2   coding comprises:

3   reordering the auxiliary input data in

4   accordance with a third interleave to provide

5   interleaved input data; and,

6   outer coding the reordered auxiliary input

7   data to provide the first stream of digital data; and,

8   wherein the replacing of the dummy first

9   stream digital data with digital data of the first

10   stream of digital data comprises:

11   reordering the dummy first stream digital

12   data and the dummy second stream digital data in

13   accordance with a fourth interleave;

14   replacing the reordered dummy first stream

15   digital data with digital data of the first stream of

16   digital data; and,

17   passing the dummy second stream digital data.

1   13. The method of claim 7 wherein the data

2   of the first stream of digital data are robust VSB

3   data, wherein the reordering of the digital data of the

4   first stream of digital data comprises:

5   providing a source of dummy VSB data and

6   dummy ATSC data;

7   replacing the dummy VSB data with the robust

8   VSB data; and,

9   reordering the robust VSB data and the dummy

10   ATSC data in accordance with the first interleave to

11   provide the third stream of digital data; and,

12   wherein the reordering of the digital data of

13   the second and third streams of digital data comprises:

14   replacing the dummy ATSC data in the third

15   stream with real ATSC data; and,

16   reordering the robust VSB data and the real

17 ATSC data in accordance with the second interleave.

1   14. The method of claim 13 wherein the outer

2   coding comprises:

3   Reed/Solomon encoding the auxiliary input

4   data;

5   reordering the Reed/Solomon encoded data in

6   accordance with a third interleave to provide

7   interleaved auxiliary input data; and,

8   outer coding the reordered Reed/Solomon

9   encoded auxiliary input data to provide the robust VSB

10 data; and,

11   wherein the replacing of the dummy VSB data

12 with the robust VSB data comprises:

13   reordering the dummy VSB data and the dummy

14 ATSC data in accordance with a fourth interleave; and,

15   replacing the reordered dummy VSB data with

16 the robust VSB data.

1   15. The method of claim 14 wherein the

2 replacing of the dummy ATSC data in the third stream

3 with real ATSC data comprises:

4   discarding the dummy ATSC data; and,

5   multiplexing the robust VSB data and the real

6 ATSC data.

1   16. A transmitter for transmitting robust

2 VSB data comprising:

3   an outer coder that receives input data and

4 that codes the input data as first robust VSB data,

5 wherein the first robust VSB data is normally ordered;

6   a first interleave that reorders the first

7 robust VSB data to provide reordered first robust VSB

8 data; and,

9   a second interleave that reorders the

10 reordered first robust VSB data to provide second

11 robust VSB data, wherein the second robust VSB data is

12 normally ordered, and wherein the first and second

13 interleaves are inversely related.

1   17.   The transmitter of claim 16 wherein the

2   first interleave is an interleaver, and wherein the

3   second interleave is a deinterleaver.

1   18.   The transmitter of claim 16 further

2   comprising a third interleave upstream of the outer

3   coder.

1   19.   The transmitter of claim 16 further

2   comprising:

3   a source of dummy robust VSB data;

4   a data replacer that replaces the dummy

5   robust VSB data with the first robust VSB data; and,

6   wherein the first interleave reorders an

7   output of the data replacer.

1   20. The transmitter of claim 19 wherein the

2 interleaver is a first interleaver, wherein the

3 transmitter further comprises a second interleaver

4 upstream of the outer coder, and wherein the source of

5 dummy first stream data comprises a third interleaver

6 upstream of the data replacer.

1   21. The transmitter of claim 16 further

2 comprising:

3   a source of dummy robust VSB data and dummy

4 ATSC data;

5   a first data replacer that replaces the dummy

6 robust VSB data with the first robust VSB data; and,

7   a second data replacer that replaces the

8 dummy ATSC data with real ATSC data; and,

9   wherein the first interleave reorders the

10 first robust VSB data and the dummy ATSC data, and

11 wherein the second interleave reorders the reordered

12 VSB data and the real ATSC data.

1   22.   The transmitter of claim 21 further

2   comprising:

3   a third interleave upstream of the outer

4   coder; and,

5   a fourth interleave upstream of the first

6   data replacer.

1   23.   The transmitter of claim 21 further

2   comprising:

3   a first Reed/Solomon encoder and a third

4   interleave upstream of the outer coder;

5   a fourth interleave upstream of the first

6   data replacer;

7   a second Reed/Solomon encoder downstream of

8   the first interleave; and,

9   a 2/3 rate coder downstream of the second

10   Reed/Solomon encoder.

1   24.   The transmitter of claim 23 wherein the

2   outer coder comprises at least first and second outer

3   coders coding the input data at different coding rates.

1   25. The transmitter of claim 21 wherein the

2   second data replacer comprises:

3   a dummy ATSC data discarder that discards the

4   dummy ATSC data; and,

5   a multiplexer that combines the reordered

6   robust VSB data and the real ATSC data.

1   26. The transmitter of claim 16 wherein the

2   outer coder comprises at least first and second outer

3   coders coding the input data at different coding rates.

1   27. The transmitter of claim 16 further

2   comprising an inner coder that inner codes the second

3   robust VSB data.

1   28. A system comprising:

2   a receiver that receives data, wherein the

3   received data comprises normally ordered first data and

4   reordered second data, wherein the normally ordered

5   first data results from inner and outer coding of first

6   input data and two interleaving operations, and wherein

7   the reordered second data results from inner coding of

8   second input data and one interleaving operation;

9   an inner decoder that inner decodes the

10   received data to recover the normally ordered first

11   data and the reordered second data;

12   a data discarder downstream of the inner

13   decoder that discards the reordered second data; and,

14   an outer decoder downstream of the data

15   discarder that outer decodes the normally ordered first

16   data.

1   29.   The system of claim 28 wherein the

2   normally ordered first data comprises normally ordered

3   robust VSB data, wherein the reordered second data

4   comprises reordered ATSC data, and wherein the data

5   discarder discards the reordered ATSC data.

1   30.   The system of claim 29 wherein the data

2   discarder discards the reordered ATSC data based upon a

3   map indicating locations for the normally ordered

4   robust VSB data and reordered ATSC data in a frame.

1   31.   The system of claim 28 wherein the

2   normally ordered first data comprises normally ordered

3   robust VSB data, wherein the reordered second data

4   comprises reordered ATSC data, and wherein the data

5   discarder discards the reordered ATSC data along with

6   transport headers and Reed/Solomon parity data.

1   32.   The system of claim 31 wherein the data

2   discarder discards the reordered ATSC data, transport

3   headers, and Reed/Solomon parity data based upon a

4   location indicating map.

1   33.   A method of processing received data

2   comprising:

3   receiving data, wherein the received data

4   comprises normally ordered first data and reordered

5   second data, wherein the normally ordered first data

6   results from inner and outer coding of first input data

7   and two interleaving operations, wherein the reordered

8   second data results from inner coding of second input

9   data and one interleaving operation;

10   inner decoding the received data to recover

11 the normally ordered first data and the reordered

12 second data; and,

13   discarding the recovered normally ordered

14 first data.

1   34.   The method of claim 33 wherein the

2   normally ordered first data comprises normally ordered

3   robust VSB data, wherein the reordered second data

4   comprises reordered ATSC data, and wherein the

5   discarding of the normally ordered first data comprises

6   discarding the normally ordered robust VSB data.

1   35. The method of claim 34 wherein the

2 discarding of the normally ordered robust VSB data is

3 based upon PID numbers.

1   36. The method of claim 33 wherein the inner

2 decoding of the received data includes reordering the

3 recovered normally ordered first data and the reordered

4 second data in accordance with an interleave comprising

5 the inverse of the one interleaving operation.

1   37. A system comprising:

2   a receiver that receives data, wherein the

3 received data comprises normally ordered first data and

4 reordered second data, wherein the normally ordered

5 first data results from two interleaving operations,

6 and wherein the reordered second data results from one

7 interleaving operation;

8   a decoder that decodes the received data to

9 recover the normally ordered first data and the

10 reordered second data; and,

11   a data discarder downstream of the decoder

12   that discards the recovered reordered second data.

1   38.   The system of claim 37 wherein the

2   normally ordered first data comprises normally ordered

3   VSB data, wherein the reordered second data comprises

4   reordered ATSC data, and wherein the data discarder

5   discards the reordered ATSC data.

1   39.   The system of claim 38 wherein the data

2   discarder discards the reordered ATSC data based upon a

3   map indicating locations for the normally ordered VSB

4   data and reordered ATSC data in a frame.

1   40.   The system of claim 37 wherein the

2   normally ordered first data comprises normally ordered

3   VSB data, wherein the reordered second data comprises

4   reordered ATSC data, and wherein the data discarder

5   discards the reordered ATSC data along with transport

6   headers and Reed/Solomon parity data.

1   41.   The system of claim 40 wherein the data

2   discarder discards the reordered ATSC data, transport

3   headers, and Reed/Solomon parity data based upon a

4   location indicating map.

1   42.   A method of processing received data

2   comprising:

3   receiving data, wherein the received data

4   comprises normally ordered first data and reordered

5   second data, wherein the normally ordered first data

6   results from inner and outer coding of first input data

7   and two interleaving operations, wherein the reordered

8   second data results from inner coding of second input

9   data and one interleaving operation;

10   decoding the received data to recover the

11   normally ordered first data and the reordered second

12   data; and,

13   upon a user selection, either reordering the

14   recovered normally ordered first data and reordered

15   second data and subsequently discarding the reordered

16   normally ordered first data or discarding the recovered

17   reordered second data and subsequently reordering the

.18   recovered normally ordered first data.

1   43. The method of claim 42 wherein the

2   recovered normally ordered first data are discarded

3   based upon PID numbers, and wherein the reordered

4   second data are discarded based upon a map.

1   44. A receiver supplying method comprising:

2   supplying first receivers, wherein each of

3   the first receivers processes received robust N level

4   VSB data and discards N level ATSC data; and,

5   supplying second receivers, wherein each of

6   the second receivers processes received N level ATSC

7   data and discards robust N level VSB data.

1   45. The receiver supplying method of claim

2   44 wherein each of the first receivers discards the

3   received N level ATSC data based upon a map, and

4   wherein each of the second receiver discards the

5   received robust N level VSB data based upon PID

6   numbers.

1   46. The receiver supplying method of claim

2   44 further comprising supplying third receivers,

3   wherein each of the third receivers selectively

4   processes both the received robust N level VSB data and

5   N level ATSC data and selectively discards the one of

6   the received robust N level VSB data and N level ATSC

7   data not processed.

1   47. The receiver supplying method of claim

2   46 wherein each of the first receivers discards the

3   received N level ATSC data based upon a map, wherein

4   each of the second receivers discards the received

5   robust N level VSB data based upon PID numbers, and

6   wherein each of the third receivers discards the

7   received N level ATSC data based upon the map and

8   discards the received robust N level VSB data based

9   upon the PID numbers.

1   48.   The receiver supplying method of claim

2   47 wherein N = 8.

1   49.   An electrical signal containing first

2   and second data symbols having the same constellation,

3   wherein the first and second data symbols have

4   different bit rates, and wherein the first and second

5   symbols are intermixed in a data frame.

1   50.   The electrical signal of claim 49

2   wherein the constellation is an 8 VSB constellation.

1   51.   The electrical signal of claim 49

2   wherein the first 8 VSB data comprises robust VSB data,

3   and wherein the second 8 VSB data comprises ATSC data.

1   52.   The electrical signal of claim 49

2   containing a data frame comprising a plurality of ATSC

3   data segments, wherein the data frame contains the

4   first and second 8 VSB data, wherein the data frame

5   further contains third 8 VSB data, wherein the first,

6   second, and third 8 VSB data have different bit rates,

7   wherein one complete Reed/Solomon block of the first 8

8   VSB data is packed into two complete ATSC data

9   segments, wherein one complete Reed/Solomon block of

10   the second 8 VSB data is packed into four complete ATSC

11   data segments, and wherein three complete Reed/Solomon

12   blocks of the third 8 VSB data are packed into four

13   complete ATSC data segments.

1   53. The electrical signal of claim 52

2   wherein the first 8 VSB data result from 1/2 rate

3   encoding, wherein the second 8 VSB data result from 1/4

4   rate encoding, and wherein the third 8 VSB data result

5   from 3/4 rate encoding.

1   54. An apparatus comprising:

2   a receiver that receives an electrical signal

3   containing first and second 8 VSB data, wherein the

4   first and second 8 VSB data have different bit rates;

5   and,

6   a data discarder that discards one of the

7   first and second 8 VSB data.

1   55.   The apparatus of claim 54 wherein the

2   first 8 VSB data comprises robust VSB data, and wherein

3   the second 8 VSB data comprises ATSC data.

1   56.   The apparatus of claim 54 wherein the

2   received electrical signal contains a data frame

3   comprising a plurality of ATSC data segments, wherein

4   the data frame contains the first and second 8 VSB

5   data, wherein the data frame further contains third 8

6   VSB data, wherein the first, second, and third 8 VSB

7   data have different bit rates, wherein one complete

8   Reed/Solomon block of the first 8 VSB data is packed

9   into two complete ATSC data segments, wherein one

10   complete Reed/Solomon block of the second 8 VSB data is

11   packed into four complete ATSC data segments, and

12   wherein three complete Reed/Solomon blocks of the third

13   8 VSB data are packed into four complete ATSC data

14   segments.

1   57. The apparatus of claim 56 wherein the

2   first 8 VSB data result from 1/2 rate encoding, wherein

3   the second 8 VSB data result from 1/4 rate encoding,

4   and wherein the third 8 VSB data result from 3/4 rate

5   encoding.

1   58. A receiver that receives an ATSC frame

2   containing a plurality of ATSC segments, wherein the

3   ATSC segments comprises a non-outer coded ATSC

4   transport header, non-outer coded ATSC Reed/Solomon

5   parity data, and outer coded data.

1   59. The receiver of claim 58 including a

2   deinterleaver that provides the outer coded data

3   between the non-outer coded ATSC transport header and

4   the non-outer coded ATSC Reed/Solomon parity data in

5   each of the ATSC segments.

1   60. The receiver of claim 58 including a

2 deinterleaver that provides the outer coded data packed

3 into Reed/Solomon blocks each containing robust VSB

4 data and robust Reed/Solomon parity data that result

5 from outer coding, wherein N complete Reed/Solomon

6 blocks are packed into M complete ATSC segments,

7 wherein N is an odd integer ≤ 3, and wherein M is an

8 even integer ≤ 4.

1   61. The receiver of claim 58 including a

2 deinterleaver that provides the outer coded data packed

3 into Reed/Solomon blocks each containing robust VSB

4 data and robust Reed/Solomon parity data that result

5 from outer coding, wherein the ATSC frame contains an

6 integral number of Reed/Solomon blocks.